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(71) Applicant: SEIKO EPSON CORP
(72) Inventor: WADA OSAMU

(54) IMAGE DISPLAY SYSTEM ADAPTIVE TO ENVIRONMENT, IMAGE PROCESSING METHOD, PROGRAM AND INFORMATION STORAGE MEDIUM

(57) Abstract:

PROBLEM TO BE SOLVED: To provide an image display system adaptive to environment, which can reproduce the color of an image matching the preference of a user at a higher speed and to provide an image processing method, a program and an information storage medium.

SOLUTION: The image display system is provided with a color gamut arithmetic section 160 that calculates a target gamut on the basis of a target profile in a target profile storage section 162 selected by a user and calculates a displayable color gamut on the basis of a projector profile in a projector profile storage section 164 and environment information from a color light sensor 60 grasping the visual environment, with a matrix generating section 122 that generates a conversion matrix depending on the relation between the target color gamut and the displayable color gamut and with a matrix conversion section 124 that uses the generated conversion matrix to covert image information, and the image display system applies matrix conversion to the image information to display an image.

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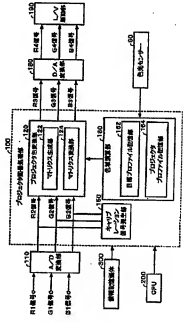

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CLAIMS

[Claim(s)]
[Claim 1]In an environmental adaptation type picture display system which changes picture information used in order to display said picture based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, and displays a picture, So that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based on a generated matrix for conversion, An environmental adaptation type picture display system characterized by said picture characteristic being a thing at least based on one side according to a picture display system and image kind including an image display means which displays a picture based on changed picture information.
[Claim 2]In claim 1, while calculating a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a color-gamut calculating means to calculate in said visual environment said matrix generating means, A picture display system generating a matrix for conversion which is different in each case when said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, in case there are a portion which laps with said target color gamut, and a portion not lapping.
[Claim 3]A picture display system when said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion which laps with said target color gamut, and a portion not lapping in claim 2, wherein said matrix generating means generates a matrix for conversion which thought the reproducibility of hue, or the reproducibility of a color gamut as important.
[Claim 4]Either characterized by comprising the following of claims 1-3.
Said color-gamut calculating means.
Said matrix generating means.
Said matrix transformation means.
Said image display means and a means to generate a picture for proofreading.

[Claim 5]An image processing method which changes picture information used based on environment information by a visual environment grasp means to grasp visual environment characterized by comprising the following in a viewing area of a picture in order to display said picture.
A matrix generation process of generating a matrix for conversion so that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user.

A matrix transformation process of changing said picture information based on a generated matrix for conversion.

[Claim 6]In claim 5, said matrix generation process, While calculating a target color gamut which is a color gamut based on said picture characteristic, based on said environment information, In said visual environment, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a process to calculate in said matrix generation process. An image processing method generating a matrix for conversion which is different in each case when said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, in case there are a portion which laps with said target color gamut, and a portion not lapping.
[Claim 7]An image processing method characterized by generating a matrix for conversion which thought the reproducibility of hue, or the reproducibility of a color gamut as important when said color gamut which can be displayed is narrower than said target color gamut at said matrix generation process in claim 6, and when there are a portion to which it laps with said target color gamut, and a portion not lapping.
[Claim 8]Either characterized by comprising the following of claims 5-7.
A process of generating a picture for proofreading in advance of amendment of said picture information.
A process of displaying a generated picture for proofreading on said viewing area, and a process of grasping visual environment in a viewing area as which said picture for proofreading was displayed, and generating said environment information.

[Claim 9]Based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, It is a program for changing picture information used in order to display said picture, By computer, are a program which can be read, and a computer so that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A program which makes it function as a matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based on a generated matrix for conversion, and is characterized by said picture characteristic being a thing at least based on one side according to a picture display system and image kind.
[Claim 10]In claim 9, while calculating a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a computer is operated as a color-gamut calculating means which calculates a color gamut which is a color gamut which can be displayed by said image display means, and which can be displayed in said visual environment, When said color gamut of said matrix generating means which can be displayed is larger than said target color gamut, A program generating a matrix for conversion which is different in each case when narrower than said target color gamut and in agreement with said target color gamut, in case there are a portion which laps with said target color gamut, and a portion not lapping.
[Claim 11]A program when said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion to which it laps with said target color gamut, and a portion not lapping in claim 10, wherein said matrix generating means generates a matrix for conversion which thought the reproducibility of hue, or the reproducibility of a color gamut as important.
[Claim 12]An information storage medium being an information storage medium which can be read and memorizing the program according to any one of claims 9 to 11 by computer.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to environmental adaptation type a picture display system, an image processing method, a program, and an information storage medium.
[0002]
[A background art and Object of the Invention] In order to unify how where a picture is in sight, convert-colors systems, such as CMS (Color Management System), are proposed.
[0003]However, how where a actual desirable picture is in sight may change with an individual or areas.
[0004]For example, although the standard display type of the picture in Japan is NTSC, the standard display type of the picture in Europe is PAL.
[0005]Therefore, when the picture which generated NTSC as a premise in Japan is displayed for Europeans for example, in Europe, a different situation from how where the picture considered that Europeans are desirable is in sight may also be generated.
[0006]For this reason, it is necessary for it to to be necessary not only to change picture information (RGB code etc.), but to change picture information according to picture characteristics, such as a display type with the selected user.
[0007]Since it is influenced by environment light etc., how where a picture is in sight needs to grasp visual environment, and needs to change picture information in consideration of visual environment.
[0008]When changing picture information according to such picture characteristics and visual environment, it is necessary to generate the information for conversion that it is used for conversion. However, memorizing the information for conversion to a storage area beforehand to all the picture characteristics assumed or visual environment will press a storage area.
[0009]It is necessary to change into real time the picture information generated by real time.
[0010]This invention is made in view of the above-mentioned technical problem, and the purpose is to provide environmental adaptation [which can reproduce more how where the picture which suited the picture characteristic with the selected user is in sight at a high speed] type a picture display system, an image processing method, a program, and an information storage medium.
[0011]
[Means for Solving the Problem]In order to solve an aforementioned problem, an environmental adaptation type picture display system concerning this invention, In an environmental adaptation type picture display system which changes picture information used in order to display said picture based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, and displays a picture, So that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based

on a generated matrix for conversion, Based on changed picture information, said picture characteristic is characterized by being a thing at least based on one side according to a picture display system and image kind including an image display means which displays a picture.
[0012]Based on environment information by a visual environment grasp means to grasp visual environment [in / in a program concerning this invention / a viewing area of a picture], It is a program for changing picture information used in order to display said picture, By computer, are a program which can be read, and a computer so that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, It is made to function as a matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based on a generated matrix for conversion, and said picture characteristic is characterized by being a thing at least based on one side according to a picture display system and image kind.
[0013]An information storage medium concerning this invention memorized a program for being an information storage medium which can be read and operating a computer as the above-mentioned means by computer.
[0014]In an image processing method which changes picture information used in order that an image processing method concerning this invention may display said picture based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, So that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A matrix generation process of generating a matrix for conversion, and a matrix transformation process of changing said picture information based on a generated matrix for conversion are included.
[0015]By according to this invention, generating a matrix for conversion as information for conversion, and changing picture information using the matrix for conversion concerned, Compared with a case where a look-up table (henceforth "LUT") is used as information for conversion, it can change into a high speed more, and an occupation of a storage area using information for conversion can be reduced.
[0016]Therefore, according to this invention, a picture which suited a picture characteristic with a selected user and visual environment can be displayed more on real time.
[0017]Here, as a picture display system, NTSC, PAL, SECAM, etc. correspond, for example. As an image kind exception, RGB, sRGB, etc. correspond, for example.
[0018]While said picture display system calculates a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a color-gamut calculating means to calculate in said visual environment said matrix generating means, When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.
[0019]Said program and said information storage medium, While calculating a target color gamut which is a color gamut based on said picture characteristic, based on said environment information, Make a computer function it as a color-gamut calculating means which calculates a color gamut which is a color gamut which can be displayed by said image display means, and which can be displayed in said visual environment, and said matrix generating means, When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.

[0020]While said matrix generation process calculates a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a process to calculate in said visual environment in said matrix generation process. When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.
[0021]With visual environment or picture characteristics, relation between a color gamut based on a picture characteristic and a color gamut which can be displayed by said image display means changes. For this reason, by the technique of changing picture information only using an independent matrix for conversion, a picture is appropriately unreproducible.
[0022]according to this invention -- above four -- a case -- dividing -- carrying out -- each case -- having responded -- conversion -- ** -- a matrix -- generating -- things -- a picture -- more -- suitable -- being reproducible .
[0023]In said picture display system, said program, and said information storage medium, said matrix generating means, When said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion which laps with said target color gamut, and a portion not lapping, it is preferred to generate a matrix for conversion which thought the reproducibility of hue or the reproducibility of a color gamut as important.
[0024]In said matrix generation process, when said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion which laps with said target color gamut, and a portion not lapping, a matrix for conversion which thought the reproducibility of hue or the reproducibility of a color gamut as important may be generated.
[0025]According to this, a picture can be more appropriately reproduced by generating a matrix for conversion which thought hue and the reproducibility of a color gamut as important.
[0026]Said picture display system Said color-gamut calculating means and said matrix generating means, Said matrix transformation means, said image display means, and a means to generate a picture for proofreading, including a projection type display which it has said image display means, The projection display of the generated picture for proofreading may be carried out to said viewing area, and said visual environment grasp means may grasp visual environment in a viewing area as which said picture for proofreading was displayed.
[0027]A projection type display simple substance can perform a calibration (proofreading), without according to this, inputting a picture for proofreading into a projection type display from external input devices, such as PC, in order to generate a picture for proofreading inside a projection type display.
[0028]A process of generating a picture for proofreading in advance of amendment of said picture information in said image processing method, A process of displaying a generated picture for proofreading on said viewing area, and a process of grasping visual environment in a viewing area as which said picture for proofreading was displayed, and generating said environment information may also be included.
[0029]According to this, visual environment can be more appropriately grasped by grasping visual environment using a picture for proofreading. Therefore, how where a picture is in sight can be reproduced more appropriately.
[0030]
[Embodiment of the Invention]The case where this invention is applied to the picture display system using a liquid crystal projector is hereafter taken for an example, and it explains, referring to drawings. The embodiment shown below does not limit at all the contents of the invention indicated to the claim. Not all the composition of being shown in following embodiments is necessarily indispensable as a solving means of the invention indicated to the claim.

[0031](Explanation of the whole system) Drawing 1 is an approximate account figure of the picture display system concerning an example of this embodiment.
[0032]The picture for predetermined presentations is projected from the projector 20 which is a kind of the projection type display of the screen 10 mostly provided in the transverse plane. The presenter 30 performs the presentation to a third party, pointing to the position of a request of the picture of the image display region 12 which is a viewing area on the screen 10 by the spot light 70 projected from the laser pointer 50.
[0033]When performing such a presentation, the classification of the screen 10 will differ from how where the picture of the image display region 12 is in sight by the environment light 80 greatly. For example, even if it is a case where the same white is displayed, it is visible to the white yellowish depending on the classification of the screen 10, or visible to the bluish white. If the environment light 80 differs even if it is a case where the same white is displayed, it is visible to bright white, or visible to dark white.
[0034]A miniaturization follows the projector 20 and carrying is also easy in recent years. For this reason, for example, although a presentation can be performed in a customer, it is difficult to adjust a color a priori according to the environment of a customer, and adjusting a color manually takes time too much at a customer.
[0035]In the conventional projector, based on the profile for input and output which shows input-output behavioral characteristics peculiar to a projector, the color is only changed and the visual environment to which the projection display of the picture is carried out is not taken into consideration. A profile means it as characteristic data.
[0036]However, if visual environment is not taken into consideration as mentioned above, it is difficult to unify how where the color of a picture is in sight. How where a color is in sight is determined by reflection of light and the target light or a penetration, and three visual factors.
[0037]According to this embodiment, the picture display system which can reproduce a suitable color is realized by grasping the visual environment reflecting reflection or a penetration of light and the target light.
[0038]By the way, when aiming at reproducing a suitable color, a suitable color may change with a user and areas reproducing a color.
[0039]For example, when using the projector 20 in Japan, it is thought that a user desires to reproduce the color of a picture with NTSC system, but when using the projector 20 in Europe, a user is considered to desire to reproduce the color of a picture with a PAL system.
[0040]In such a case, it is required to reproduce the color of the picture which a user desires, without calling at the area where the projector 20 is used.
[0041]The projector 20 consists of these embodiments so that the color of a picture can be adjusted based on selection of a user's picture display system etc.
[0042]As shown in drawing 1, the colored light sensor 60 which functions as a visual environment grasp means to grasp visual environment is formed, and, specifically, the environment information from the colored light sensor 60 is inputted into the projector 20. Specifically, the colored light sensor 60 measures the environment information (specifically tristimulus value of RGB or XYZ) of the image display region 12 in the screen 10.
[0043]Based on selection information, such as a picture display system of the environment information from the colored light sensor 60, and a user, etc., the matrix for conversion is generated in the projector 20, and the conversion method which changes the picture information used for image display is provided in it using the matrix for conversion concerned.
[0044]The picture display system which can reproduce the color of a suitable picture which suited a user's liking is realized by grasping visual environment based on environment information, and grasping a user's liking based on selection information.
[0045]In this embodiment, while calculating the color gamut which can be displayed by the projector 20 under the visual environment at the time of presentation execution and which can be displayed, it

is calculating and asking for the target color gamut in the picture display system with the selected user. And image processing is performed so that the color gamut which can be displayed and target color gamut for which it asked may be compared and the color possible nearest to a target color gamut can be displayed by the projector 20.

[0046](Explanation of a color gamut) Drawing 2 is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, the case where a target color gamut and the color gamut of drawing 2 (A) which can be displayed correspond is shown, and drawing 2 (B) is a mimetic diagram showing the case where the color gamut which can be displayed is larger than a target color gamut. Drawing 3 is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, drawing 3 (A) shows the case where the color gamut which can be displayed is narrower than a target color gamut, and drawing 3 (B) is a mimetic diagram showing the case where there are a portion to which a target color gamut laps with the color gamut which can be displayed, and a portion not lapping.

[0047]In drawing 2 (A) – drawing 3 (B), a solid line shows a target color gamut and a dashed line shows the color gamut which can be displayed. The intersection of the line which is going to the triangular central part from each vertex of each color gamut of triangular shape is a white point.

[0048]The color gamut of drawing 2 (A) – drawing 3 (B) is defined on the flat surface of a chromaticity coordinate (x, y). Here, it is $x=X/(X+Y+Z)$ and is $y=Y/(X+Y+Z)$. Each of X, Y, and Z is a stimulus value in a CIE standard colorimetric system.

[0049]Since there are two change factors of a picture characteristic and visual environment, the relation between a target color gamut and the color gamut which can be displayed is not fixed, and is what [a thing / change] that is divided roughly into four patterns shown in drawing 2 (A) – drawing 3 (B).

[0050]The techniques of conversion of picture information differ a little by to which it corresponds among these four patterns. For example, even when the color gamut which can be displayed covers all of target color gamuts and the usual conversion technique is used like [in the case of being shown in drawing 2 (A) and drawing 2 (B)], a target picture can be reproduced appropriately.

[0051]However, like [in the case of being shown in drawing 3 (A) and drawing 3 (B)], when the color gamut which can be displayed does not cover all of target color gamuts, by the usual conversion technique, a target picture cannot be reproduced appropriately.

[0052]In such a case, it is necessary to perform color-gamut mapping (it may be called color gamut compression.) which matches with the color inside a target color gamut the color of the target color gamut of the color-gamut exterior which can be displayed.

[0053]According to this embodiment, one of the technique over which priority is given to a color gamut, and the techniques over which priority is given to hue is used as the technique of color-gamut mapping.

[0054]Drawing 4 is a mimetic diagram showing the color gamut (mapping color gamut) after color-gamut mapping, drawing 4 (A) shows the mapping color gamut at the time of color-gamut priority, and drawing 4 (B) is a mimetic diagram showing the mapping color gamut at the time of hue priority.

[0055]In drawing 4 (A) and drawing 4 (B), a dashed line shows the color gamut which can be displayed and a two-dot chain line shows a target color gamut. Drawing 4 (A) and drawing 4 (B) show the example of color-gamut mapping in the case where a part of the target color gamut and the color gamut which can be displayed which are shown in drawing 3 (B) lap.

[0056]For example, as shown in drawing 4 (A), the peak D of a target color gamut is in the inside of color-gamut ABC which can be displayed, but the peak E and the peak F of a target color gamut are located in the exterior of color-gamut ABC which can be displayed. For this reason, the way things stand, the color of the peak E and peak F neighborhood can be reproduced.

[0057]Then, when there is an unreproducible color specification demand, in order to reappear in the nearest possible color, color-gamut mapping is performed.

[0058]According to this embodiment, priority is given to a color gamut or hue, and color-gamut

mapping is performed.
[0059]For example, when it gives priority to a color gamut, as shown in drawing 4 (A), the point I possible nearest to the point H and the vertex F possible nearest to the vertex E among the intersections of the triangle DEF and triangle ABC is searched for. Since the vertex D is in the inside of triangle ABC, it is applicable as it is as the vertex G of a new color gamut.
[0060]Thus, when the called-for triangle GHI gives priority to a color gamut, it becomes a mapping color gamut at the time of considering that a mapping color gamut becomes large as much as possible.
[0061]For example, when it gives priority to hue, as shown in drawing 4 (B), it asks for the intersections K and L of the line segment which goes to the white point Y from the vertex of the triangle DEF, and each neighborhood of triangle ABC. Since the vertex D is in the inside of triangle ABC, it is applicable as it is as the vertex J of a new color gamut.
[0062]Thus, when the called-for triangle JKL gives priority to hue, it becomes a mapping color gamut at the time of considering that hue can be reproduced as correctly as possible. There are three attributes of color of brightness, chroma saturation, and hue in a color. Among these, human being's eyes sense hue the most sensitive. Therefore, the color nearer to a target color gamut is reproducible by giving priority to hue and asking for a mapping color gamut using the projector 20.
[0063]The mapping color gamut in the case of being shown in drawing 2 (A) and drawing 2 (B) can apply a target color gamut as it is.
[0064]According to this embodiment, the matrix for conversion for changing picture information so that the mapping color gamut determined as mentioned above can be reproduced is generated, and picture information is changed using the generated matrix for conversion.
[0065]The functional block of the image processing portion of the projector 20 including (explanation of a functional block), next these matrix generating means, etc. is explained.
[0066]Drawing 5 is a functional block diagram of the image processing portion 100 in the projector 20 concerning an example of this embodiment.
[0067]R1 signal which constitutes the RGB code of the analog format sent from PC etc. from the projector 20, G1 signal and B1 signal are inputted into the A/D conversion part 110, and convert colors are performed by the projector image processing portion 100 controlled by CPU200 in R2 signal of digital format, G2 signal, and B-2 signal.
[0068]And R3 signal by which convert colors were carried out, G3 signal, and B3 signal are inputted into the D/A conversion part 180, R4 signal by which analogue conversion was carried out, G4 signal, and B4 signal are inputted into the L/V (light valve) actuator 190 which is a part of image display means, a liquid crystal light valve is driven, and the projection display of the picture is performed.
[0069]The projector image processing portion 100 is constituted including the projector convert-colors part 120, the color-gamut operation part 160, and the calibration signal generator 150.
[0070]The color-gamut operation part 160 is constituted including the target profile storage parts store 162 and the projector profile storage parts store 164.
[0071]The calibration signal generator 150 generates a calibration (for proofreading) picture signal. This calibration picture signal is inputted into the projector convert-colors part 120 as R2 signal of digital format, G2 signal, and a B-2 signal like the signal outputted from the A/D conversion part 110.
[0072]Thus, projector 20 simple substance can perform a calibration, without inputting a calibration picture signal into the projector 20 from external input devices, such as PC, in order to generate a calibration picture signal inside the projector 20.
[0073]the projector convert-colors part 120 — each digital signal (R — two signals) of RGB from the calibration signal generator 150 G2 signal and B-2 signal are changed into an RGB digital signal (R3 signal, G3 signal, B3 signal) suitable for a projector output with reference to the projector profile which the projector profile storage parts store 164 has managed.

[0074]The matrix generation part 122 which generates the matrix for conversion for the projector convert-colors part 120 to change each digital signal (R2 signal, G2 signal, B-2 signal) which is picture information, It is constituted including the matrix transformation part 124 which changes picture information using the generated matrix for conversion.
[0075]The matrix generation part 122 generates the matrix for conversion so that the mapping color gamut calculated by the color-gamut operation part 160 can more specifically be reproduced.
[0076]Next, the color-gamut operation part 160 is explained.
[0077]The color-gamut operation part 160 is constituted including the target profile storage parts store 162 and the projector profile storage parts store 164. The target profile as whom the color-gamut operation part 160 was more specifically chosen by the user, The mapping color gamut explained using drawing 2 - drawing 4 is calculated so that it may be the favorite color which the user chose and may become how where the color of the picture which suited visual environment is in sight based on the environment information from the colored light sensor 60, and a projector profile.
[0078]Here, a target profile is a kind of the input-output-behavioral-characteristics data of a target color. More specifically, a target profile is the data which defined matching with a tristimulus value (X, Y, Z) as the RGB luminance signal, for example. According to this embodiment, the target profile is realized by the matrix which changes a RGB luminance signal into a tristimulus value (X, Y, Z). Corresponding to two or more sorts of picture characteristics selectable in a user, two or more sorts of profiles are provided as a target profile.
[0079]A projector profile is a kind of the input-output-behavioral-characteristics data corresponding to the model of projector 20. More specifically, a projector profile is the data which defined matching with a RGB luminance signal and the tristimulus value (X, Y, Z) actually acquired when a projector displays the picture based on the RGB luminance signal concerned under ideal environment, for example. According to this embodiment, the projector profile is realized by the matrix which changes a RGB luminance signal into a tristimulus value (X, Y, Z).
[0080]It explains flowing into (explanation of the flow of image processing), next image processing using these each part using a flow chart.
[0081]Drawing 6 is a flow chart which shows the procedure of image processing concerning an example of this embodiment.
[0082]First, before a presentation is performed, the user of the projector 20 chooses one picture characteristic from two or more sorts of picture characteristics assigned to the manual operation button of the projector 20. For example, provide the button for selection of picture characteristics, such as NTSC, PAL, and SECAM, in the outside surface of the projector 20, a user is made to specifically push the button for selection, and one picture characteristic is made to choose.
[0083]This selection information is transmitted to the projector image processing portion 100. The projector image processing portion 100 sets a target profile's flag chosen from two or more target profiles of the target profile storage parts store 162 based on the selection information concerned.
[0084]Thus, the projector image processing portion 100 chooses a target profile according to a user's selection (Step S2).
[0085]After a target profile is chosen according to a user's selection, the projector 20 generates a calibration signal (R2, G2, B-2) from the calibration signal generator 150.
[0086]The calibration signal generator 150 outputs the calibration signal concerned to the projector convert-colors part 120.
[0087]Using the default (initial state) matrix for conversion, the projector convert-colors part 120 changes a calibration signal, and outputs it as a digital RGB signal (R3, G3, B3).
[0088]And the D/A conversion part 180 changes a digital RGB signal into an analog RGB signal (R4, G4, B4). And the L/V actuator 190 drives a liquid crystal light valve based on an analog RGB signal (R4, G4, B4). And the projector 20 carries out the projection display of the calibration picture to the image display region 12 (step S4).

[0089]Where a calibration picture is displayed on the image display region 12, the colored light sensor 60 detects a tristimulus value, in order to grasp visual environment (Step S6).
[0090]Thus, visual environment can be more appropriately grasped by grasping visual environment using a calibration picture. Therefore, how where a picture is in sight can be reproduced more appropriately.
[0091]And the projector convert-colors part 120 generates the matrix for conversion based on the grasped visual environment, and changes picture information using the matrix for conversion concerned (Step S8).
[0092]Here, it explains more concretely about this matrix generation conversion process (Step S8).
[0093]Drawing 7 is a flow chart which shows the procedure of the matrix generation conversion process concerning an example of this embodiment.
[0094]The color-gamut operation part 160 calculates and asks for a target color gamut based on the target profile chosen from the target profile storage parts store 162. The color-gamut operation part 160 calculates and asks for the color gamut of the projector 20 which can be displayed based on the tristimulus value detected by the projector profile and the colored light sensor 60 which were memorized by the projector profile storage parts store 164 (Step S12).
[0095]And the color-gamut operation part 160 compares the color gamut which can be displayed and target color gamut for which it asked by an operation (Step S12).
[0096]First, when the color gamut which can be displayed is in agreement with a target color gamut (Step S14) (i.e., when shown in drawing 2 (B)), the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut of the triangle of the solid line of drawing 2 (B) can be reproduced (Step S16).
[0097]When the color gamut which can be displayed is larger than a target color gamut (Step S18) (i.e., when shown in drawing 2 (A)), the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut of the triangle of the solid line of drawing 2 (A) can be reproduced (Step S20).
[0098]When the color gamut which can be displayed is narrower than a target color gamut (Step S22) (i.e., when shown in drawing 3 (A)), the matrix generation part 122, The matrix for conversion is generated so that the mapping color gamut which gave priority to reappearance of the color gamut and hue which are shown in drawing 4 (A) or drawing 4 (B) can be reproduced (Step S24).
[0099]In other than the above-mentioned 3 patterns (Step S14, S18, S22), when there are a portion to which the color gamut which can be displayed laps with a target color gamut, and a portion not lapping, it is a case where it is shown in drawing 3 (B). In this case, the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut which gave priority to reappearance of the color gamut and hue which are shown in drawing 4 (A) or drawing 4 (B) can be reproduced (Step S26).
[0100]All the matrices for conversion generated by matrix generation (Step S16, S20, S24, S26) differ.
[0101]And the matrix transformation part 124 performs convert colors (conversion of picture information) using the matrix for conversion generated by the matrix generation part 122 (Step S28). The matrix transformation part 124 changes a digital RGB signal (R2, G2, B-2) using three-line the matrix for conversion of three rows, and, more specifically, outputs it as a digital RGB signal (R3, G3, B3).
[0102]It will be set to =(R3, G3, B3) M (R2, G2, B-2) if this is expressed with expression. Here, M is a matrix for conversion.
[0103]The projector 20 carries out D/A conversion of the changed digital RGB signal (R3, G3, B3) using the D/A conversion part 180, and displays a actual presentation image using the changed analog RGB signal (R4, G4, B4) (Step S10).
[0104]As mentioned above, according to this embodiment, picture information is changed using the matrix for conversion so that the picture which suited the picture characteristic which the user

chose can be displayed.
[0105]The picture display system which can display by this the picture which suited a user's liking is realizable.
[0106]In this embodiment, the projection display of the picture is carried out in consideration of visual environment by grasping visual environment using the colored light sensor 60.
[0107]By this, it can be adapted for the visual environment at the time of image display, a picture can be displayed, and the same picture can be displayed, without depending the difference of a display ring boundary on the environment applied by absorbing. Therefore, at several different places, the almost same color is reproducible in a short time.
[0108]By changing picture information not using LUT but using the matrix for conversion, picture information is more convertible for a high speed, and there are also few occupations of a storage area and they can be managed with this embodiment.
[0109]the time of generating the matrix for conversion in this embodiment -- the relation between the color gamut which can be displayed, and a target color gamut -- four patterns -- a case -- dividing -- carrying out -- each case -- having responded -- conversion -- ** -- a matrix -- generating -- **** .
[0110]The relation between the color gamut which can be displayed, and a target color gamut changes with selections of the environment where the projector 20 is applied, and the picture characteristic by a user. For this reason, it is necessary to generate the suitable matrix for conversion according to the relation between the color gamut which can be displayed, and a target color gamut.
[0111]According to this embodiment, the suitable matrix for conversion is generable by generating the matrix for conversion according to four patterns assumed.
[0112]Since a target color gamut can be applied as a mapping color gamut almost as it is in the case of the pattern shown in drawing 2 (A) and drawing 2 (B), compared with the case where color-gamut mapping shown in drawing 3 (A) and drawing 3 (B) is required, the matrix for conversion is generable at high speed.
[0113]When color-gamut mapping shown in drawing 3 (A) and drawing 3 (B) is required, compared with the case where the matrix for conversion which thought the reproducibility of brightness or chroma saturation as important is used, a picture can be more appropriately reproduced by using the matrix for conversion which thought the reproducibility of hue, or the reproducibility of the color gamut as important.
[0114](Explanation of hardware) As hardware used in addition for each part mentioned above, the following are applicable, for example.
[0115]For example, as the A/D conversion part 110, for example as the D/A conversion part 180, an A/D converter etc., For example, as the L/V actuators 190, such as a D/A converter, a liquid crystal light valve drive driver etc. can realize an image processing circuit, ASIC, etc. as the projector convert-colors part 120, for example, using CPU, RAM, etc. for example as the color-gamut operation part 160. It may realize in hardware like a circuit and these each part may be realized by software like a driver or a program.
[0116]As shown in drawing 5, a program may be read in the information storage medium 300, and the function of these each part may be realized. As the information storage medium 300, CD-ROM, DVD-ROM, ROM, RAM, HDD, etc. can be applied, and the read system of the program may be a contact method, or may be a noncontact method, for example.
[0117]It is also possible to realize each function mentioned above by downloading the program for replacing with the information storage medium 300 and realizing each function mentioned above from a host device etc. via a transmission line. That is, the program for realizing each function mentioned above may be embodied by the subcarrier.
[0118]The following hardwares are applicable to the colored light sensor 60.
[0119]For example, the op amplifier etc. which amplify the A/D converter which changes into a

digital signal the analog signal from a light filter and a photo-diode, and a photo-diode which penetrates each stimulus value selectively, and the digital signal concerned are applicable.
[0120]As mentioned above, although the suitable embodiment which applied this invention has been described, application of this invention is not limited to the example mentioned above.
[0121](Modification) For example, as a target profile who mentioned above, picture characteristics, such as an image kind exception, such as RGB and sRGB, may be applied, for example besides picture display systems, such as NTSC.
[0122]As a visual environment grasp means, it is also possible to apply the imaging means of a CCD camera, a CMOS camera, etc., for example besides colored light sensor 60.
[0123]Although the screen 10 mentioned above was a reflection type thing, it may be a transmission type thing.
[0124]Although the matrix for conversion mentioned above was an independent matrix, convert colors may be performed combining two or more matrices. For example, convert colors may be performed combining the inverse transformation matrix according to an output unit, and the environmental correction matrix reflecting environment information.
[0125]This invention can be applied, also when performing image display by displaying means other than a projection type image display device like the projector mentioned above and performing a presentation etc. As such a displaying means, for example CRT besides a liquid crystal projector (Cathode RayTube), PDP (Plasma Display Panel), FED (FieldEmission Display), Display devices, such as EL (Electro Luminescence) and a direct viewing type liquid crystal display, the projector using DMD (Digital Micromirror Device), etc. correspond. DMD is a trademark of U.S. Texas Instruments, Inc. A projector may not be restricted to a front projection type thing, but may be a back projection type thing.
[0126]This invention is effective also when performing a meeting, medical science, the design fashion field, operating activities, commercials, education, and image display [in / general images, such as a movie, TV, video, and a game, etc. / further] besides a presentation.
[0127]The image display device (for example, projector 20) of a simple substance may realize, and two or more processing units may realize dispersedly the function of the projector image processing portion 100 of the projector 20 mentioned above (it is distributed processing with the projector 20 and PC).

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]This invention relates to environmental adaptation type a picture display system, an image processing method, a program, and an information storage medium.

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TECHNICAL PROBLEM

[A background art and Object of the Invention] In order to unify how where a picture is in sight, convert-colors systems, such as CMS (Color Management System), are proposed.
[0003]However, how where a actual desirable picture is in sight may change with an individual or areas.
[0004]For example, although a standard display type of a picture in Japan is NTSC, a standard display type of a picture in Europe is PAL.
[0005]Therefore, when a picture which generated NTSC as a premise in Japan is displayed for Europeans for example, in Europe, a different situation from how where a picture considered that Europeans are desirable is in sight may also be generated.
[0006]For this reason, it is necessary for it to to be necessary not only to change picture information (RGB code etc.), but to change picture information according to picture characteristics, such as a display type with a selected user.
[0007]Since it is influenced by environment light etc., how where a picture is in sight needs to grasp visual environment, and needs to change picture information in consideration of visual environment.
[0008]When changing picture information according to such picture characteristics and visual environment, it is necessary to generate the information for conversion that it is used for conversion. However, memorizing the information for conversion to a storage area beforehand to all the picture characteristics assumed or visual environment will press a storage area.
[0009]It is necessary to change into real time the picture information generated by real time.
[0010]This invention is made in view of the above-mentioned technical problem, and the purpose is to provide environmental adaptation [which can reproduce more how where the picture which suited the picture characteristic with the selected user is in sight at a high speed] type a picture display system, an image processing method, a program, and an information storage medium.

[Translation done.]

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MEANS

[Means for Solving the Problem]In order to solve an aforementioned problem, an environmental adaptation type picture display system concerning this invention, In an environmental adaptation type picture display system which changes picture information used in order to display said picture based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, and displays a picture, So that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based on a generated matrix for conversion, Based on changed picture information, said picture characteristic is characterized by being a thing at least based on one side according to a picture display system and image kind including an image display means which displays a picture.
[0012]Based on environment information by a visual environment grasp means to grasp visual environment [in / in a program concerning this invention / a viewing area of a picture], It is a program for changing picture information used in order to display said picture, By computer, are a program which can be read, and a computer so that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, It is made to function as a matrix generating means which generates a matrix for conversion, and a matrix transformation means to change said picture information based on a generated matrix for conversion, and said picture characteristic is characterized by being a thing at least based on one side according to a picture display system and image kind.
[0013]An information storage medium concerning this invention memorized a program for being an information storage medium which can be read and operating a computer as the above-mentioned means by computer.
[0014]In an image processing method which changes picture information used in order that an image processing method concerning this invention may display said picture based on environment information by a visual environment grasp means to grasp visual environment in a viewing area of a picture, So that a picture which suited said visual environment and said picture characteristic may be displayed based on a picture characteristic with said environment information and a selected user, A matrix generation process of generating a matrix for conversion, and a matrix transformation process of changing said picture information based on a generated matrix for conversion are included.
[0015]By according to this invention, generating a matrix for conversion as information for conversion, and changing picture information using the matrix for conversion concerned, Compared with a case where a look-up table (henceforth "LUT") is used as information for conversion, it can change into a high speed more, and an occupation of a storage area using information for conversion can be reduced.

[0016]Therefore, according to this invention, a picture which suited a picture characteristic with a selected user and visual environment can be displayed more on real time.
[0017]Here, as a picture display system, NTSC, PAL, SECAM, etc. correspond, for example. As an image kind exception, RGB, sRGB, etc. correspond, for example.
[0018]While said picture display system calculates a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a color-gamut calculating means to calculate in said visual environment said matrix generating means, When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.
[0019]Said program and said information storage medium, While calculating a target color gamut which is a color gamut based on said picture characteristic, based on said environment information, Make a computer function it as a color-gamut calculating means which calculates a color gamut which is a color gamut which can be displayed by said image display means, and which can be displayed in said visual environment, and said matrix generating means, When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.
[0020]While said matrix generation process calculates a target color gamut which is a color gamut based on said picture characteristic, Based on said environment information, a color gamut which is a color gamut which can be displayed by said image display means and which can be displayed including a process to calculate in said visual environment in said matrix generation process. When said color gamut which can be displayed is larger than said target color gamut, and narrower than said target color gamut and it is in agreement with said target color gamut, a matrix for conversion which is different in each case in case there are a portion which laps with said target color gamut, and a portion not lapping may be generated.
[0021]With visual environment or picture characteristics, relation between a color gamut based on a picture characteristic and a color gamut which can be displayed by said image display means changes. For this reason, by the technique of changing picture information only using an independent matrix for conversion, a picture is appropriately unreproducible.
[0022]according to this invention -- above four -- a case -- dividing -- carrying out -- each case -- having responded -- conversion -- ** -- a matrix -- generating -- things -- a picture -- more -- suitable -- being reproducible .
[0023]In said picture display system, said program, and said information storage medium, said matrix generating means, When said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion which laps with said target color gamut, and a portion not lapping, it is preferred to generate a matrix for conversion which thought the reproducibility of hue or the reproducibility of a color gamut as important.
[0024]In said matrix generation process, when said color gamut which can be displayed is narrower than said target color gamut, and when there are a portion which laps with said target color gamut, and a portion not lapping, a matrix for conversion which thought the reproducibility of hue or the reproducibility of a color gamut as important may be generated.
[0025]According to this, a picture can be more appropriately reproduced by generating a matrix for conversion which thought hue and the reproducibility of a color gamut as important.
[0026]Said picture display system Said color-gamut calculating means and said matrix generating means, Said matrix transformation means, said image display means, and a means to generate a picture for proofreading, including a projection type display which it has said image display means,

The projection display of the generated picture for proofreading may be carried out to said viewing area, and said visual environment grasp means may grasp visual environment in a viewing area as which said picture for proofreading was displayed.

[0027]A projection type display simple substance can perform a calibration (proofreading), without according to this, inputting a picture for proofreading into a projection type display from external input devices, such as PC, in order to generate a picture for proofreading inside a projection type display.

[0028]A process of generating a picture for proofreading in advance of amendment of said picture information in said image processing method, A process of displaying a generated picture for proofreading on said viewing area, and a process of grasping visual environment in a viewing area as which said picture for proofreading was displayed, and generating said environment information may also be included.

[0029]According to this, visual environment can be more appropriately grasped by grasping visual environment using a picture for proofreading. Therefore, how where a picture is in sight can be reproduced more appropriately.

[0030]

[Embodiment of the Invention]The case where this invention is applied to the picture display system using a liquid crystal projector is hereafter taken for an example, and it explains, referring to drawings. The embodiment shown below does not limit at all the contents of the invention indicated to the claim. Not all the composition of being shown in following embodiments is necessarily indispensable as a solving means of the invention indicated to the claim.

[0031](Explanation of the whole system) Drawing 1 is an approximate account figure of the picture display system concerning an example of this embodiment.

[0032]The picture for predetermined presentations is projected from the projector 20 which is a kind of the projection type display of the screen 10 mostly provided in the transverse plane. The presenter 30 performs the presentation to a third party, pointing to the position of a request of the picture of the image display region 12 which is a viewing area on the screen 10 by the spot light 70 projected from the laser pointer 50.

[0033]When performing such a presentation, the classification of the screen 10 will differ from how where the picture of the image display region 12 is in sight by the environment light 80 greatly. For example, even if it is a case where the same white is displayed, it is visible to the white yellowish depending on the classification of the screen 10, or visible to the bluish white. If the environment light 80 differs even if it is a case where the same white is displayed, it is visible to bright white, or visible to dark white.

[0034]A miniaturization follows the projector 20 and carrying is also easy in recent years. For this reason, for example, although a presentation can be performed in a customer, it is difficult to adjust a color a priori according to the environment of a customer, and adjusting a color manually takes time too much at a customer.

[0035]In the conventional projector, based on the profile for input and output which shows input–output behavioral characteristics peculiar to a projector, the color is only changed and the visual environment to which the projection display of the picture is carried out is not taken into consideration. A profile means it as characteristic data.

[0036]However, if visual environment is not taken into consideration as mentioned above, it is difficult to unify how where the color of a picture is in sight. How where a color is in sight is determined by reflection of light and the target light or a penetration, and three visual factors.

[0037]According to this embodiment, the picture display system which can reproduce a suitable color is realized by grasping the visual environment reflecting reflection or a penetration of light and the target light.

[0038]By the way, when aiming at reproducing a suitable color, a suitable color may change with a user and areas reproducing a color.

[0039]For example, when using the projector 20 in Japan, it is thought that a user desires to reproduce the color of a picture with NTSC system, but when using the projector 20 in Europe, a user is considered to desire to reproduce the color of a picture with a PAL system.
[0040]In such a case, it is required to reproduce the color of the picture which a user desires, without calling at the area where the projector 20 is used.
[0041]The projector 20 consists of these embodiments so that the color of a picture can be adjusted based on selection of a user's picture display system etc.
[0042]As shown in drawing 1, the colored light sensor 60 which functions as a visual environment grasp means to grasp visual environment is formed, and, specifically, the environment information from the colored light sensor 60 is inputted into the projector 20. Specifically, the colored light sensor 60 measures the environment information (specifically tristimulus value of RGB or XYZ) of the image display region 12 in the screen 10.
[0043]Based on selection information, such as a picture display system of the environment information from the colored light sensor 60, and a user, etc., the matrix for conversion is generated in the projector 20, and the conversion method which changes the picture information used for image display is provided in it using the matrix for conversion concerned.
[0044]The picture display system which can reproduce the color of a suitable picture which suited a user's liking is realized by grasping visual environment based on environment information, and grasping a user's liking based on selection information.
[0045]In this embodiment, while calculating the color gamut which can be displayed by the projector 20 under the visual environment at the time of presentation execution and which can be displayed, it is calculating and asking for the target color gamut in the picture display system with the selected user. And image processing is performed so that the color gamut which can be displayed and target color gamut for which it asked may be compared and the color possible nearest to a target color gamut can be displayed by the projector 20.
[0046](Explanation of a color gamut) Drawing 2 is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, the case where a target color gamut and the color gamut of drawing 2 (A) which can be displayed correspond is shown, and drawing 2 (B) is a mimetic diagram showing the case where the color gamut which can be displayed is larger than a target color gamut. Drawing 3 is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, drawing 3 (A) shows the case where the color gamut which can be displayed is narrower than a target color gamut, and drawing 3 (B) is a mimetic diagram showing the case where there are a portion to which a target color gamut laps with the color gamut which can be displayed, and a portion not lapping.
[0047]In drawing 2 (A) – drawing 3 (B), a solid line shows a target color gamut and a dashed line shows the color gamut which can be displayed. The intersection of the line which is going to the triangular central part from each vertex of each color gamut of triangular shape is a white point.
[0048]The color gamut of drawing 2 (A) – drawing 3 (B) is defined on the flat surface of a chromaticity coordinate (x, y). Here, it is x=X/(X+Y+Z) and is y=Y/(X+Y+Z). Each of X, Y, and Z is a stimulus value in a CIE standard colorimetric system.
[0049]Since there are two change factors of a picture characteristic and visual environment, the relation between a target color gamut and the color gamut which can be displayed is not fixed, and is what [a thing / change] that is divided roughly into four patterns shown in drawing 2 (A) – drawing 3 (B).
[0050]The techniques of conversion of picture information differ a little by to which it corresponds among these four patterns. For example, even when the color gamut which can be displayed covers all of target color gamuts and the usual conversion technique is used like [in the case of being shown in drawing 2 (A) and drawing 2 (B)], a target picture can be reproduced appropriately.
[0051]However, like [in the case of being shown in drawing 3 (A) and drawing 3 (B)], when the color gamut which can be displayed does not cover all of target color gamuts, by the usual conversion

technique, a target picture cannot be reproduced appropriately.
[0052]In such a case, it is necessary to perform color-gamut mapping (it may be called color gamut compression.) which matches with the color inside a target color gamut the color of the target color gamut of the color-gamut exterior which can be displayed.
[0053]According to this embodiment, one of the technique over which priority is given to a color gamut, and the techniques over which priority is given to hue is used as the technique of color-gamut mapping.
[0054]Drawing 4 is a mimetic diagram showing the color gamut (mapping color gamut) after color-gamut mapping, drawing 4 (A) shows the mapping color gamut at the time of color-gamut priority, and drawing 4 (B) is a mimetic diagram showing the mapping color gamut at the time of hue priority.
[0055]In drawing 4 (A) and drawing 4 (B), a dashed line shows the color gamut which can be displayed and a two-dot chain line shows a target color gamut. Drawing 4 (A) and drawing 4 (B) show the example of color-gamut mapping in the case where a part of the target color gamut and the color gamut which can be displayed which are shown in drawing 3 (B) lap.
[0056]For example, as shown in drawing 4 (A), the peak D of a target color gamut is in the inside of color-gamut ABC which can be displayed, but the peak E and the peak F of a target color gamut are located in the exterior of color-gamut ABC which can be displayed. For this reason, the way things stand, the color of the peak E and peak F neighborhood can be reproduced.
[0057]Then, when there is an unreproducible color specification demand, in order to reappear in the nearest possible color, color-gamut mapping is performed.
[0058]According to this embodiment, priority is given to a color gamut or hue, and color-gamut mapping is performed.
[0059]For example, when it gives priority to a color gamut, as shown in drawing 4 (A), the point I possible nearest to the point H and the vertex F possible nearest to the vertex E among the intersections of the triangle DEF and triangle ABC is searched for. Since the vertex D is in the inside of triangle ABC, it is applicable as it is as the vertex G of a new color gamut.
[0060]Thus, when the called-for triangle GHI gives priority to a color gamut, it becomes a mapping color gamut at the time of considering that a mapping color gamut becomes large as much as possible.
[0061]For example, when it gives priority to hue, as shown in drawing 4 (B), it asks for the intersections K and L of the line segment which goes to the white point Y from the vertex of the triangle DEF, and each neighborhood of triangle ABC. Since the vertex D is in the inside of triangle ABC, it is applicable as it is as the vertex J of a new color gamut.
[0062]Thus, when the called-for triangle JKL gives priority to hue, it becomes a mapping color gamut at the time of considering that hue can be reproduced as correctly as possible. There are three attributes of color of brightness, chroma saturation, and hue in a color. Among these, human being's eyes sense hue the most sensitive. Therefore, the color nearer to a target color gamut is reproducible by giving priority to hue and asking for a mapping color gamut using the projector 20.
[0063]The mapping color gamut in the case of being shown in drawing 2 (A) and drawing 2 (B) can apply a target color gamut as it is.
[0064]According to this embodiment, the matrix for conversion for changing picture information so that the mapping color gamut determined as mentioned above can be reproduced is generated, and picture information is changed using the generated matrix for conversion.
[0065]The functional block of the image processing portion of the projector 20 including (explanation of a functional block), next these matrix generating means, etc. is explained.
[0066]Drawing 5 is a functional block diagram of the image processing portion 100 in the projector 20 concerning an example of this embodiment.
[0067]R1 signal which constitutes the RGB code of the analog format sent from PC etc. from the projector 20, G1 signal and B1 signal are inputted into the A/D conversion part 110, and convert colors are performed by the projector image processing portion 100 controlled by CPU200 in R2

signal of digital format, G2 signal, and B-2 signal.
[0068]And R3 signal by which convert colors were carried out, G3 signal, and B3 signal are inputted into the D/A conversion part 180, R4 signal by which analogue conversion was carried out, G4 signal, and B4 signal are inputted into the L/V (light valve) actuator 190 which is a part of image display means, a liquid crystal light valve is driven, and the projection display of the picture is performed.
[0069]The projector image processing portion 100 is constituted including the projector convert-colors part 120, the color-gamut operation part 160, and the calibration signal generator 150.
[0070]The color-gamut operation part 160 is constituted including the target profile storage parts store 162 and the projector profile storage parts store 164.
[0071]The calibration signal generator 150 generates a calibration (for proofreading) picture signal. This calibration picture signal is inputted into the projector convert-colors part 120 as R2 signal of digital format, G2 signal, and a B-2 signal like the signal outputted from the A/D conversion part 110.
[0072]Thus, projector 20 simple substance can perform a calibration, without inputting a calibration picture signal into the projector 20 from external input devices, such as PC, in order to generate a calibration picture signal inside the projector 20.
[0073]the projector convert-colors part 120 -- each digital signal (R -- two signals) of RGB from the calibration signal generator 150 G2 signal and B-2 signal are changed into an RGB digital signal (R3 signal, G3 signal, B3 signal) suitable for a projector output with reference to the projector profile which the projector profile storage parts store 164 has managed.
[0074]The matrix generation part 122 which generates the matrix for conversion for the projector convert-colors part 120 to change each digital signal (R2 signal, G2 signal, B-2 signal) which is picture information, It is constituted including the matrix transformation part 124 which changes picture information using the generated matrix for conversion.
[0075]The matrix generation part 122 generates the matrix for conversion so that the mapping color gamut calculated by the color-gamut operation part 160 can more specifically be reproduced.
[0076]Next, the color-gamut operation part 160 is explained.
[0077]The color-gamut operation part 160 is constituted including the target profile storage parts store 162 and the projector profile storage parts store 164. The target profile as whom the color-gamut operation part 160 was more specifically chosen by the user, The mapping color gamut explained using drawing 2 - drawing 4 is calculated so that it may be the favorite color which the user chose and may become how where the color of the picture which suited visual environment is in sight based on the environment information from the colored light sensor 60, and a projector profile.
[0078]Here, a target profile is a kind of the input-output-behavioral-characteristics data of a target color. More specifically, a target profile is the data which defined matching with a tristimulus value (X, Y, Z) as the RGB luminance signal, for example. According to this embodiment, the target profile is realized by the matrix which changes a RGB luminance signal into a tristimulus value (X, Y, Z). Corresponding to two or more sorts of picture characteristics selectable in a user, two or more sorts of profiles are provided as a target profile.
[0079]A projector profile is a kind of the input-output-behavioral-characteristics data corresponding to the model of projector 20. More specifically, a projector profile is the data which defined matching with a RGB luminance signal and the tristimulus value (X, Y, Z) actually acquired when a projector displays the picture based on the RGB luminance signal concerned under ideal environment, for example. According to this embodiment, the projector profile is realized by the matrix which changes a RGB luminance signal into a tristimulus value (X, Y, Z).
[0080]It explains flowing into (explanation of the flow of image processing), next image processing using these each part using a flow chart.
[0081]Drawing 6 is a flow chart which shows the procedure of image processing concerning an

example of this embodiment.
[0082]First, before a presentation is performed, the user of the projector 20 chooses one picture characteristic from two or more sorts of picture characteristics assigned to the manual operation button of the projector 20. For example, provide the button for selection of picture characteristics, such as NTSC, PAL, and SECAM, in the outside surface of the projector 20, a user is made to specifically push the button for selection, and one picture characteristic is made to choose.
[0083]This selection information is transmitted to the projector image processing portion 100. The projector image processing portion 100 sets a target profile's flag chosen from two or more target profiles of the target profile storage parts store 162 based on the selection information concerned.
[0084]Thus, the projector image processing portion 100 chooses a target profile according to a user's selection (Step S2).
[0085]After a target profile is chosen according to a user's selection, the projector 20 generates a calibration signal (R2, G2, B-2) from the calibration signal generator 150.
[0086]The calibration signal generator 150 outputs the calibration signal concerned to the projector convert-colors part 120.
[0087]Using the default (initial state) matrix for conversion, the projector convert-colors part 120 changes a calibration signal, and outputs it as a digital RGB signal (R3, G3, B3).
[0088]And the D/A conversion part 180 changes a digital RGB signal into an analog RGB signal (R4, G4, B4). And the L/V actuator 190 drives a liquid crystal light valve based on an analog RGB signal (R4, G4, B4). And the projector 20 carries out the projection display of the calibration picture to the image display region 12 (step S4).
[0089]Where a calibration picture is displayed on the image display region 12, the colored light sensor 60 detects a tristimulus value, in order to grasp visual environment (Step S6).
[0090]Thus, visual environment can be more appropriately grasped by grasping visual environment using a calibration picture. Therefore, how where a picture is in sight can be reproduced more appropriately.
[0091]And the projector convert-colors part 120 generates the matrix for conversion based on the grasped visual environment, and changes picture information using the matrix for conversion concerned (Step S8).
[0092]Here, it explains more concretely about this matrix generation conversion process (Step S8).
[0093]Drawing 7 is a flow chart which shows the procedure of the matrix generation conversion process concerning an example of this embodiment.
[0094]The color-gamut operation part 160 calculates and asks for a target color gamut based on the target profile chosen from the target profile storage parts store 162. The color-gamut operation part 160 calculates and asks for the color gamut of the projector 20 which can be displayed based on the tristimulus value detected by the projector profile and the colored light sensor 60 which were memorized by the projector profile storage parts store 164 (Step S12).
[0095]And the color-gamut operation part 160 compares the color gamut which can be displayed and target color gamut for which it asked by an operation (Step S12).
[0096]First, when the color gamut which can be displayed is in agreement with a target color gamut (Step S14) (i.e., when shown in drawing 2 (B)), the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut of the triangle of the solid line of drawing 2 (B) can be reproduced (Step S16).
[0097]When the color gamut which can be displayed is larger than a target color gamut (Step S18) (i.e., when shown in drawing 2 (A)), the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut of the triangle of the solid line of drawing 2 (A) can be reproduced (Step S20).
[0098]When the color gamut which can be displayed is narrower than a target color gamut (Step S22) (i.e., when shown in drawing 3 (A)), the matrix generation part 122, The matrix for conversion is generated so that the mapping color gamut which gave priority to reappearance of the color gamut

and hue which are shown in drawing 4 (A) or drawing 4 (B) can be reproduced (Step S24).
[0099]In other than the above-mentioned 3 patterns (Step S14, S18, S22), when there are a portion to which the color gamut which can be displayed laps with a target color gamut, and a portion not lapping, it is a case where it is shown in drawing 3 (B). In this case, the matrix generation part 122 generates the matrix for conversion so that the mapping color gamut which gave priority to reappearance of the color gamut and hue which are shown in drawing 4 (A) or drawing 4 (B) can be reproduced (Step S26).
[0100]All the matrices for conversion generated by matrix generation (Step S16, S20, S24, S26) differ.
[0101]And the matrix transformation part 124 performs convert colors (conversion of picture information) using the matrix for conversion generated by the matrix generation part 122 (Step S28). The matrix transformation part 124 changes a digital RGB signal (R2, G2, B-2) using three-line the matrix for conversion of three rows, and, more specifically, outputs it as a digital RGB signal (R3, G3, B3).
[0102]It will be set to =(R3, G3, B3) M (R2, G2, B-2) if this is expressed with expression. Here, M is a matrix for conversion.
[0103]The projector 20 carries out D/A conversion of the changed digital RGB signal (R3, G3, B3) using the D/A conversion part 180, and displays a actual presentation image using the changed analog RGB signal (R4, G4, B4) (Step S10).
[0104]As mentioned above, according to this embodiment, picture information is changed using the matrix for conversion so that the picture which suited the picture characteristic which the user chose can be displayed.
[0105]The picture display system which can display by this the picture which suited a user's liking is realizable.
[0106]In this embodiment, the projection display of the picture is carried out in consideration of visual environment by grasping visual environment using the colored light sensor 60.
[0107]By this, it can be adapted for the visual environment at the time of image display, a picture can be displayed, and the same picture can be displayed, without depending the difference of a display ring boundary on the environment applied by absorbing. Therefore, at several different places, the almost same color is reproducible in a short time.
[0108]By changing picture information not using LUT but using the matrix for conversion, picture information is more convertible for a high speed, and there are also few occupations of a storage area and they can be managed with this embodiment.
[0109]the time of generating the matrix for conversion in this embodiment -- the relation between the color gamut which can be displayed, and a target color gamut -- four patterns -- a case -- dividing -- carrying out -- each case -- having responded -- conversion -- ** -- a matrix -- generating -- **** .
[0110]The relation between the color gamut which can be displayed, and a target color gamut changes with selections of the environment where the projector 20 is applied, and the picture characteristic by a user. For this reason, it is necessary to generate the suitable matrix for conversion according to the relation between the color gamut which can be displayed, and a target color gamut.
[0111]According to this embodiment, the suitable matrix for conversion is generable by generating the matrix for conversion according to four patterns assumed.
[0112]Since a target color gamut can be applied as a mapping color gamut almost as it is in the case of the pattern shown in drawing 2 (A) and drawing 2 (B), compared with the case where color-gamut mapping shown in drawing 3 (A) and drawing 3 (B) is required, the matrix for conversion is generable at high speed.
[0113]When color-gamut mapping shown in drawing 3 (A) and drawing 3 (B) is required, compared with the case where the matrix for conversion which thought the reproducibility of brightness or

chroma saturation as important is used, a picture can be more appropriately reproduced by using the matrix for conversion which thought the reproducibility of hue, or the reproducibility of the color gamut as important.

[0114](Explanation of hardware) As hardware used in addition for each part mentioned above, the following are applicable, for example.

[0115]For example, as the A/D conversion part 110, for example as the D/A conversion part 180, an A/D converter etc., For example, as the L/V actuators 190, such as a D/A converter, a liquid crystal light valve drive driver etc. can realize an image processing circuit, ASIC, etc. as the projector convert-colors part 120, for example, using CPU, RAM, etc. for example as the color-gamut operation part 160. It may realize in hardware like a circuit and these each part may be realized by software like a driver or a program.

[0116]As shown in drawing 5, a program may be read in the information storage medium 300, and the function of these each part may be realized. As the information storage medium 300, CD-ROM, DVD-ROM, ROM, RAM, HDD, etc. can be applied, and the read system of the program may be a contact method, or may be a noncontact method, for example.

[0117]It is also possible to realize each function mentioned above by downloading the program for replacing with the information storage medium 300 and realizing each function mentioned above from a host device etc. via a transmission line. That is, the program for realizing each function mentioned above may be embodied by the subcarrier.

[0118]The following hardwares are applicable to the colored light sensor 60.

[0119]For example, the op amplifier etc. which amplify the A/D converter which changes into a digital signal the analog signal from a light filter and a photo-diode, and a photo-diode which penetrates each stimulus value selectively, and the digital signal concerned are applicable.

[0120]As mentioned above, although the suitable embodiment which applied this invention has been described, application of this invention is not limited to the example mentioned above.

[0121](Modification) For example, as a target profile who mentioned above, picture characteristics, such as an image kind exception, such as RGB and sRGB, may be applied, for example besides picture display systems, such as NTSC.

[0122]As a visual environment grasp means, it is also possible to apply the imaging means of a CCD camera, a CMOS camera, etc., for example besides colored light sensor 60.

[0123]Although the screen 10 mentioned above was a reflection type thing, it may be a transmission type thing.

[0124]Although the matrix for conversion mentioned above was an independent matrix, convert colors may be performed combining two or more matrices. For example, convert colors may be performed combining the inverse transformation matrix according to an output unit, and the environmental correction matrix reflecting environment information.

[0125]This invention can be applied, also when performing image display by displaying means other than a projection type image display device like the projector mentioned above and performing a presentation etc. As such a displaying means, for example CRT besides a liquid crystal projector (Cathode RayTube), PDP (Plasma Display Panel), FED (FieldEmission Display), Display devices, such as EL (Electro Luminescence) and a direct viewing type liquid crystal display, the projector using DMD (Digital Micromirror Device), etc. correspond. DMD is a trademark of U.S. Texas Instruments, Inc. A projector may not be restricted to a front projection type thing, but may be a back projection type thing.

[0126]This invention is effective also when performing a meeting, medical science, the design fashion field, operating activities, commercials, education, and image display [in / general images, such as a movie, TV, video, and a game, etc. / further] besides a presentation.

[0127]The image display device (for example, projector 20) of a simple substance may realize, and two or more processing units may realize dispersedly the function of the projector image processing portion 100 of the projector 20 mentioned above (it is distributed processing with the projector 20

and PC).

[Translation done.]

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an approximate account figure of the picture display system concerning an example of this embodiment.
[Drawing 2]It is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, and the case where a target color gamut and the color gamut of drawing 2 (A) which can be displayed correspond is shown, and drawing 2 (B) is a mimetic diagram showing the case where the color gamut which can be displayed is larger than a target color gamut.
[Drawing 3]It is a mimetic diagram showing a target color gamut and the color gamut which can be displayed, and drawing 3 (A) shows the case where the color gamut which can be displayed is narrower than a target color gamut, and drawing 3 (B) is a mimetic diagram showing the case where there are a portion to which a target color gamut laps with the color gamut which can be displayed, and a portion not lapping.
[Drawing 4]It is a mimetic diagram showing the color gamut after color-gamut mapping, and drawing 4 (A) shows the color gamut at the time of color-gamut priority, and drawing 4 (B) is a mimetic diagram showing the color gamut at the time of hue priority.
[Drawing 5]It is a functional block diagram of the image processing portion in the projector concerning an example of this embodiment.
[Drawing 6]It is a flow chart which shows the procedure of image processing concerning an example of this embodiment.
[Drawing 7]It is a flow chart which shows the procedure of the matrix generation conversion process concerning an example of this embodiment.
[Description of Notations]
20 Projector
50 Laser pointer
60 Colored light sensor
80 Environment light
120 Projector convert-colors part
122 Matrix generation part
124 Matrix transformation part
150 Calibration signal generator
160 Color-gamut operation part
162 Target profile storage parts store
164 Projector profile storage parts store
300 Information storage medium

[Translation done.]

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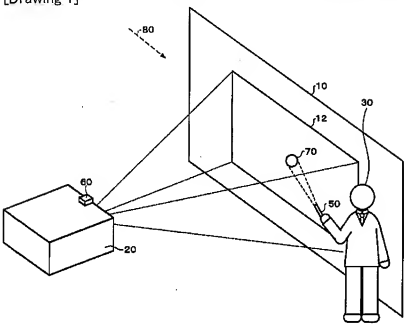
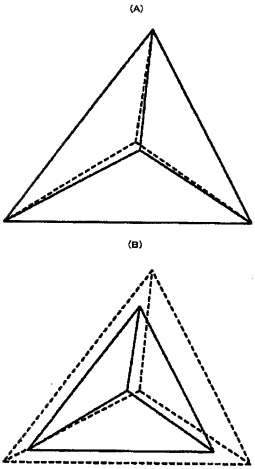
DRAWINGS

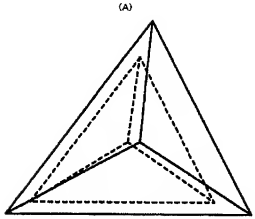
[Drawing 1]

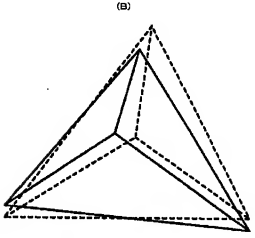


[Drawing 2]

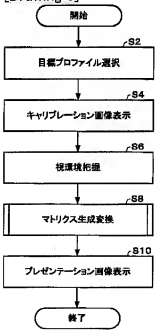


[Drawing 3]

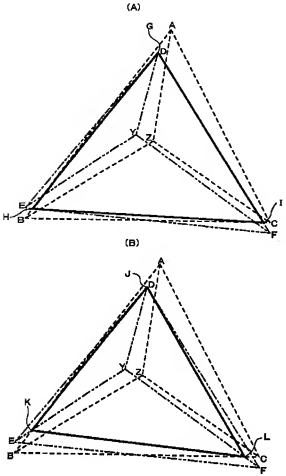




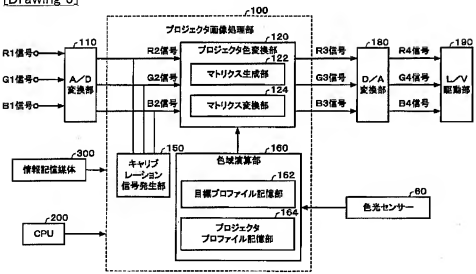
[Drawing 6]



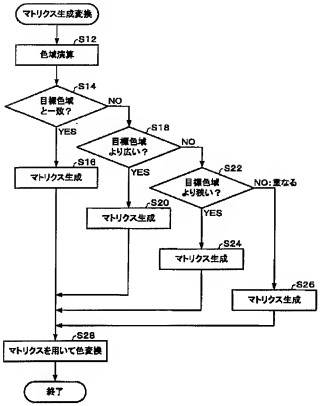
[Drawing 4]



[Drawing 5]



[Drawing 7]



[Translation done.]